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A Bridge to the Revised Intermediate Licence

Tony Jones G7ETW looks this month at what is required for existing Foundation licence holders to bridge the knowledge gap in order to start the new Intermediate licence training.

This article is aimed at Foundation amateurs (M3 and M6 callsigns mainly) who got their licences under the pre-2019 syllabus and want to take a 2019 syllabus Intermediate course. If that's you, you have a problem: the new Intermediate course assumes you know things you were never taught. Doubtless many such amateurs will have learned these things – and many more – for themselves, but let me fill in this 'knowledge gap' just to be on the safe side.

I am talking about syllabus differences, please note. The new RSGB *Foundation Licence Manual* has topics that weren't in the old book but which also aren't in the 2019 syllabus! After much deliberation, I have not included them.

Technical Basics

Circuits with series and parallel loads

Figs. 1a and **1b** show circuits with two identical bulbs wired differently to illustrate how voltage and current divide in series and parallel circuits.

In the series circuit, the potential difference is equally split. The current passes through one bulb, then the other; it is the same everywhere. Putting a third bulb in would make the others dimmer.

In the parallel circuit, each bulb 'sees' all of the potential difference and passes its own current. Putting a third bulb in would not affect the others. (A car is wired like this.)

The power in the parallel circuit is four times that of the series one. If that's not obvious, some Ohm's Law revision is probably a good idea!

Digital Signals

I covered digital signals in a previous article 'Digital Signals: Foundation and Intermediate', featured in the 2019 issue, so please review it there.

Transmitters

Sidebands. When a lower frequency AC waveform such as audio 'mixes with' or 'modulates' an RF frequency ('carrier') waveform, new frequencies are created called 'sidebands'.

Amplitude Modulation AM, **Fig. 2**, has two sidebands: an 'Upper sideband' and a 'Lower sideband'. These are symmetrically distributed around the carrier.

'Single sideband' is derived from AM. In SSB one sideband and the carrier are dropped (suppressed, filtered out), leaving just the USB or the LSB to be transmitted. This is more efficient, but SSB receivers need to be more complex.

Two examples of narrow bandwidth digital signals are PSK31 and FT8.

Receivers

See 'Digital Signals: Foundation and Intermediate'.

Feeders and Antennas

Twin Feeder (also called Open Feeder), see **Fig. 3**.

- Twin Feeder has equal and opposite RF AC currents in two spaced-apart wires.
- Twin Feeder is balanced and coax isn't.

RF Connectors

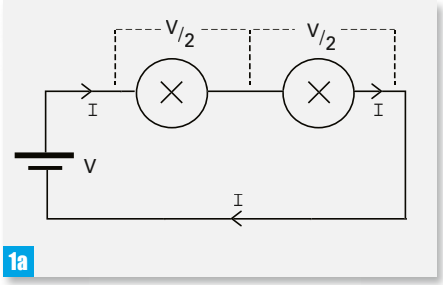
In addition to BNCs and PL259s, SMA and N-type male plugs need to be recognised, see **Fig. 4**.

Radiation Patterns

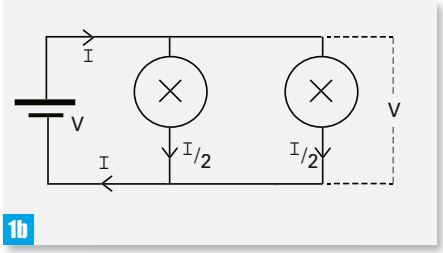
Radiation patterns, also known as 'Polar Plots', show in two dimensions (because we're looking down) where an antenna converts AC current and voltage into electromagnetic radiation.

Fig. 5a shows a radiation pattern for a horizontally-polarised Yagi mounted horizontally on a vertical mast. There is noticeable directionality; almost all of the RF is projected and received in a narrow horizontal forwards-looking beam.

Fig. 5b shows a horizontally-polarised half-wave dipole similarly mounted. Transmission is forwards and backwards, broadside-on in a circular pattern. But



1a



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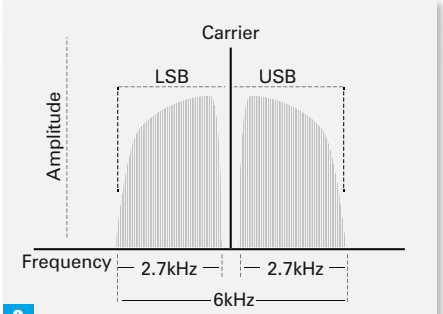

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Fig. 1a: Two bulbs wired in series. Both take the same current but have half the voltage across each.
Fig. 1b: Two bulbs wired in parallel. Both have the same voltage across them but take half the total current.
Fig. 2: An amplitude modulated (AM) signal – a constant carrier and two sidebands created as a result of the modulating audio signal.

Fig. 3: Twin feeder, showing currents in each leg.
Fig. 4: SMA and N-type coaxial connectors.

there is still some directionality. The vertically polarised dipole's polar plot in **Fig. 5c** is less intuitive. We are looking end-on into the vertical wire or rod, which radiates and receives equally in all horizontal directions.

Licence Regulations

Broadcasting

Transmitting 'for general reception, that is to anybody that may be listening' is not allowed. This is what amateurs have always meant, and still do, by 'broadcasting'. It is not helpful that the word 'broadcasting' no longer appears in the Foundation syllabus in this context.

The term 'broadcasting' is used as part of the RF spectrum allocation table in the Operating section. Think of the British Broadcasting Corporation, who transmit 24/7 one-way to millions of people. We don't do that; we're not broadcasters.

Playing music and offensive or threatening language

The new syllabus describes these as 'unacceptable'. Not illegal, please note. Many repeaters suffer from such abuse every day. Anyone hearing such behaviour on air should ignore it and not respond.

When to give a callsign on air

Callsigns should be given on change of digital protocol. This is no different to doing so on change of mode.

Change of supervisor is now a specific identification requirement. It is the supervisor's callsign the supervised amateur station uses on air, so that makes sense too.

Phrases to remember

Amateurs should test their station 'from time to time.'

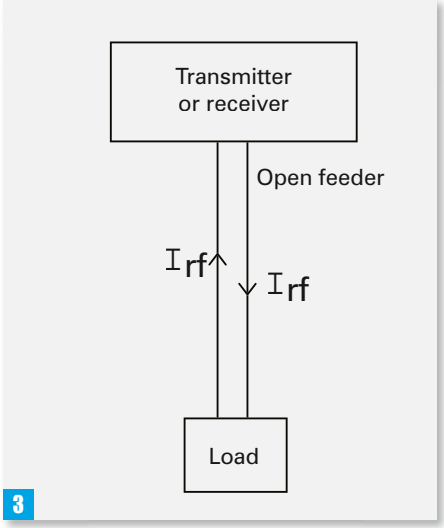
Amateurs should transmit their callsign 'as often as practicable' – this replaced 'every 15 minutes' some years ago.

Operating

Embedded callsigns

A subtlety concerning digital modes has arisen in the case of 'Digital Voice' or DV transmitters. If I set up a DMR transmitter, for my use, I program in my callsign.

If I lend my DMR radio to a friend, their spoken callsign on transmitting will not match mine in the outgoing data stream. My friend will be breaking the law because the operator must be 'clearly identified at all times'.



Bandplan and Schedule

The new syllabus explicitly says

- Operating simplex through repeaters should not take place.
- Amateurs may transmit and receive through satellites. The 2m band has frequencies for this, which should not be used for terrestrial operating.

These are essentially the same 'requirement', which is to know and obey the Bandplan. These are not 'must' instructions, please note, which keeping to the Schedule certainly would be. I have met many amateurs (of all levels) who are woolly about the difference. Let me recap.

The Schedule is UK law. It's like the Deeds to a house – it says what parts of the radio spectrum are 'ours'. The UK 40m band, as specified by the Schedule, is 7.00 to 7.20MHz. If I transmit on 7.25MHz I am breaking the law and I could be prosecuted.

The Bandplan is a 'gentleman's agreement' for allocating the allocated spectrum for use on different modes. This is drawn up by the International Amateur Radio Union (IARU) and is a worldwide thing. But it is not law. UK amateurs obviously 'should' keep to it, but it is not true to say that we 'must'.

If I decide to have an FM QSO on 7.10 MHz – there is no FM allocation on 40m – that's not illegal. I'd be causing enormous interference to other radio amateurs, not just UK ones. but provided I stay in-band, no offence would be committed.

Desk microphones and soundcards are covered. Operators must make take care that input levels are not set too high or over-modulated (or over-deviated for FM) transmissions could result in frequency-spread interference.

EMC

Care should be made when installing and testing radios in modern cars because essential systems such as engine management computers and anti-lock brakes could be affected. Initial testing should be done while not moving.

Dealing with interference

The new syllabus gives the social aspects of such situations more importance than before. Amateurs accused of causing interference should:

- Self-test in the first instance
- Be diplomatic
- Investigate systematically by trying different bands and power levels
- Offer practical help such as filters to improve the immunity of affected neighbour's equipment
- Keep a log (so should the neighbour)
- Get help from the RSGB and other amateurs

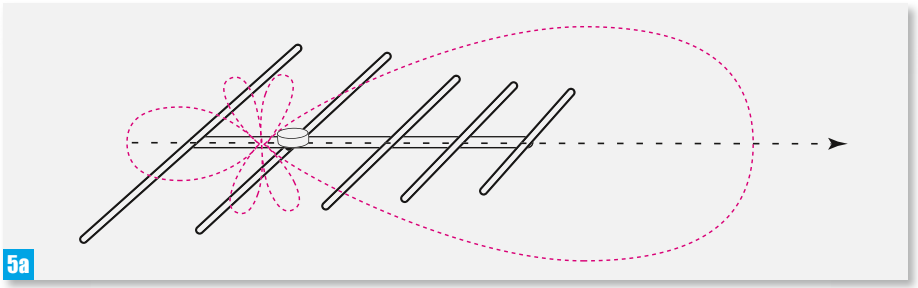
If the neighbour calls in Ofcom – and it is they that must do this, as the 'victim' – correct amateur behaviour is to co-operate fully. Amateurs are not automatically guilty and Ofcom does know that. Neighbours risk paying a fee if their equipment is to blame.

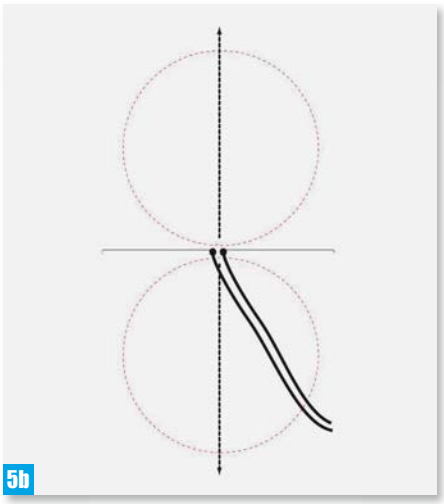
Safety

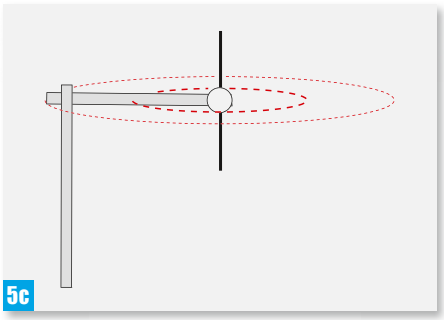
(much increased at New Foundation)

Residual Current Circuit Breaker with Overload protection devices offer significantly more protection than fuses, which only 'blow' if a large live-to-earth or live-to-neutral current flows. An RCBO constantly monitors the earth current, and if this exceeds even a tiny amount – typically 30 mA – the circuit breaker will 'trip' and instantly disconnect the mains power.

PME earthing has thankfully gone from the syllabus but amateurs must know to consult the 'District Network Operator' – the organisation that actually provides the mains electricity – before installing or making changes to an RF earth.







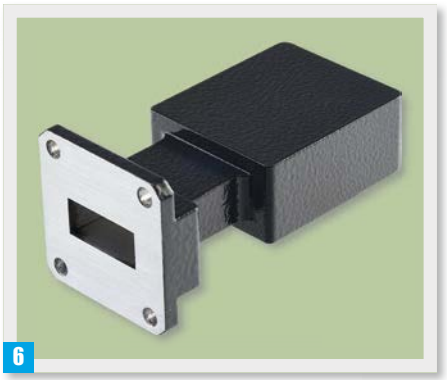


Fig. 5a: Polar plot of a horizontal Yagi (seen from above). Most of the power is concentrated towards the front but there will inevitably be some radiation off the back and the sides (known as sidelobes).
Fig. 5b: Polar plot of half-wave dipole as seen from above – no radiation off the ends but equal radiation off both sides.
Fig. 5c: Polar plot of radiation from a vertical dipole – the radiation pattern is a circle around the antenna (but seen from the side would be similar to that of a horizontal dipole when seen from above).
Fig. 6: Simple waveguide antenna.

Charging of rechargeable batteries is a hazard. Different types of rechargeable battery need different types of charger. Incorrect charger use can be dangerous, even leading to explosions.

RF burns are painful and to be avoided.

Fig. 6 is a Waveguide Antenna, used in microwave systems. The 'Antennas and Feeders' section does not mention these, but Safety tells us waveguides and other high-gain antennas should not be looked into when transmitting.

ICNIRP – the International Commission on Non-Ionising Radiation Protection – provides guidance on safe levels of RF.

Car batteries are dangerous too. They can provide very large currents, and there is the risk of acid burns.

Safe use of tools and soldering have become part of the new syllabus but the right to construct transmitters is still given at Intermediate. Soldering is a particular hazard because of:

- The risk of solder-splashes to the eyes (eye protection is recommended)
- Fumes, which can cause breathing problems for some people (asthma sufferers, for example)

It is not illegal, by the way, despite what many people may say, to use 60% lead 40% tin solder.

Safety is everyone's responsibility. In the shack, mobile or a field, everyone, including Foundation amateurs, must be safety conscious.

Conclusion

There may be a few tiny points I've omitted but there you have it. I hope that helps. My own club is considering offering a Foundation Syllabus Transition 'course', with no exam naturally, for students who find themselves in this situation. Perhaps other club tutors could consider this? Half a day would be long enough.

Pre-2019 Intermediate amateurs wanting to study for Advanced face a similar difficulty – a rather bigger one, in fact, because the 2019 Intermediate syllabus has changed far more than Foundation did. I am happy to write a similar article for Intermediate if readers think that would help.

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